ULTIMATE EARS
BY LOGITECH

Ultimate Ears ProTech Skill Series

/ // Using In-Ear Monitors

Part 1. IEM Signal Chain and Equipment

Overview

In-Ear Monitors (IEM) provide an excellent method of tailoring mixes for each individual musician in a performance setting while allowing superior instrument separation and hearing protection. The transition from monitor wedges to In-Ear monitors requires the development of a new set of mix management and control skills. In part 1 of this 2 part series, we review the basic signal chain and equipment used to deliver separate mixes to performers using wireless transmitters and In-Ear monitors for performance monitoring purposes.

Note

This paper only discusses devices used in the signal chain that are specifically part of an In-Ear Monitor system. We do not identify brands of stage gear nor do we discuss the detailed use of particular pieces of equipment. Part 2 of this series will take a more in-depth approach and will review techniques used to "tune" a mix and will also relate more detailed information regarding specific equipment and settings.

Basic Equipment in the IEM Signal Chain

Although signal chains will be somewhat different and will contain "secret sauce" based on each engineer's experience and electrical current requirements, there is certain gear that will be found across most stage IEM systems. The equipment listed below is in order following the typical signal as it travels from its origin (mic, bass DI, etc) to the In-Ear Monitor, where it is EQ'd then sent individually mixed, back to each performer.

Note

Specific performer gear like foot pedals, preamps and gain control devices are considered the musician's personal gear and are not considered as a topic for this paper. For instance, a particular vocalist may have a partial ear to a specific tube microphone preamp that conditions the microphone signal before it hits the mixing console; those devices will be covered in part 2 of this series.

Snake

The snake is a stage-located single point of entry for all signals originating on the stage. Snakes can be either analog or digital. The snake typically will have 16 to 64 (or more) XLR inputs that feed each instrument and all microphones directly back to the monitor mixing console.

Mixing Console

The mixing console takes all input signals from the snake, both from instruments and vocal microphones. Mixing consoles are either analog or digital. Analog consoles typically require outboard gear, such as multi-band compressors and graphic EQs that manage the dynamics and time-based effects on any given signal. Digital mixers typically have the compressor and graphic EQ built-in. Today digital consoles are finding their way on to many stages because of their extreme convenience, amazing amount of control and good sound. The mixing console's primary functions are that it allows the monitor engineer to set signal strength, apply EQ, pan and apply dynamics and effects. These functions allow the engineer to create a custom mix for the performer through the combination of each signal with each other in certain sound level ratios to create summed signals, or mixes. The console then allows the engineer to route these separate mixes to individual outputs that then become inputs to a wireless transmitter unit. This unit transmits the signals to the wireless receiver units worn by the artists on stage. Ultimate Ears Custom In-Ear monitors are attached to the wireless receiver and deliver the signal mix directly into the artist ears.

Equalizer

An equalizer allows control and shaping of small ranges of frequencies so that the monitor engineer can adjust and customize the tone of the mix in the performer's ears. EQ examples include adding gain to a range of frequencies between 2-5 kHz to add "cut" and "presence" to vocals or adding boost at 60Hz to accentuate the kick drum for a drummer. Additionally, equalizers are commonly used to solve problems such as removing annoying frequencies (noise) or frequencies that add with a vocalist's "head voice" that cause muddiness and lack of clarity. Using the analog mixer, some Eking can be accomplished on each signal's respective channel. It is most flexible and a best practice to locate a separate graphic EQ at the "send" from the board for each individual performer mix. Digital boards typically have integrated EQ functionality that can be patched anywhere along the internal signal chain in the mixer console. However, it is still best practice to patch an EQ block right at the point in the signal chain before it hits the consoles "send" jack.

Compressor/Limiter

A compressor/limiter is used at different points in the signal chain to protect the artist from potentially dangerous bursts of sound and to control the mix. In a live sound stage system, it is typical to experience overload distortion and signal peaks. In some cases, extreme sound pressure levels can cause ear damage. A good example of the benefits of the compressor/limiter is the kick drum. A kick drum is a very transient instrument and drummers typically want to hear it quite loud in their personal IEM mix. However, the loud kick drum signal works against getting a suitably loud overall mix because it can and will overwhelm the input signals from other instruments which can cause distortion. In this case, the monitor engineer can apply a multi-band (frequency dependent) compressor to limit the peaks of the kick drum and allow the overall mix to be louder thus avoiding the kick drum's tendency to distort the overall mix. Most digital boards have built in compression/limiter technology that is in line with each input signal anywhere within the internal signal chain.
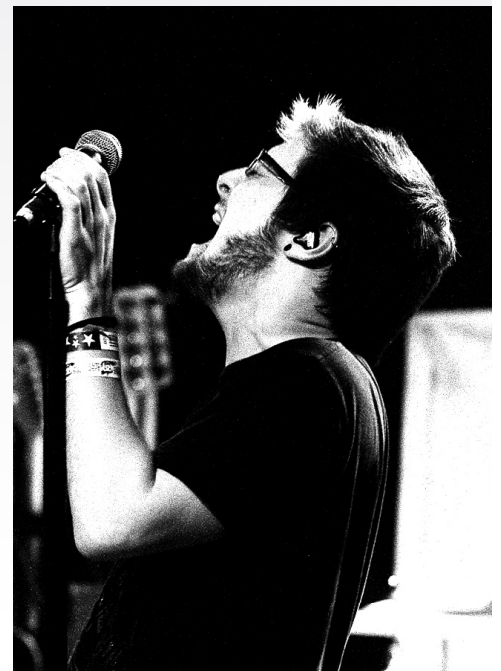
Wireless Transmitter

The wireless transmitter accepts either a mono or stereo mix from the aux or Omni send jack(s) on the monitor console. The transmitter is typically rack mounted in the proximity of the monitor console. The transmitter takes the wired output signal from the mixer and sends it wirelessly to the performer's belt pack on stage.

Wireless Receiver (belt pack)

The wireless receiver is attached by a clip to the performer's clothing or person. It captures the wireless signal from the transmitter. It is battery powered and has electronic circuitry to deliver very loud Sound Pressure Levels (SPL's) to the performers ears via the industry standard Ultimate Ears Custom In-Ear Monitors that connect to the wireless receiver through a standard 3.5mm jack.

RF Spectrum Scanner Software (additional tool)

Running wireless In-Ear Monitor systems can be simplified with the help of this software tool. It allows viewing of the RF spectrum of the venue and assists in finding open transmission channels for the wireless units.

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Sample Live Configuration for In-Ear Monitor Mixing

Instruments

Microphone Preamp (Optional)

Graphic Equalizer

Multi-band Compressor (Optional)

Wireless Transmitter

Wireless Belt Pack

Ultimate Ears IEMs